

Removal Recommendation for Drinking Water Taste and Odor Problems Beneficial Use Impairment

Rochester Embayment Area of Concern

Request

The purpose of this document is to support the recommendation to remove the Drinking Water Taste and Odor Problems Beneficial Use Impairment (BUI) from the Rochester Embayment Area of Concern (AOC), per the process outlined in *Restoring United States Great Lakes Areas of Concern: Delisting Principles and Guidelines* (U.S. Policy Committee 2001).

Rochester Embayment AOC Background

The Rochester Embayment AOC encompasses the Rochester Embayment of Lake Ontario (the area of shoreline between Bogus Point in the town of Parma and Ninemile Point in the town of Webster). The northern boundary is delineated by a straight line between these two points. The AOC also includes the 6 miles of the Genesee River from the Lower Falls to the mouth of the river at the Embayment (see Figure 1).

The Rochester Embayment Remedial Action Plan (RAP) process began in 1990 and resulted in the production of the Stage I RAP in 1993, identifying existing conditions and data for each BUI in the AOC, as well as identifying each BUI as impaired, not impaired, or unknown. Subsequent to the issuance of the Stage I report, a Stage II RAP was published in 1997, and an update to the Stage II RAP was published in 1999, which was then followed by a 2002 RAP addendum. These documents assess existing conditions, highlight activities to improve AOC conditions implemented to date, and identify and rank programs to address BUIs. Delisting criteria were first developed in the 2002 RAP addendum.

The remedial measures of the Rochester Embayment RAP address the sources and causes of BUIs in the AOC that have been identified as originating in the watershed or the AOC itself, and contributing to impairments in the AOC. The intent of the AOC program is to remedy the impairment when the AOC is the source. Studies since the original BUI status determination have identified lakewide impairments that do not originate from pollutants (or other causes of impairments) within the Rochester Embayment watershed. Additionally, since the original status determination it has come to light that impairments should only be listed when the AOC itself is the source, not the upper watershed. The official status (impaired, not impaired, or unknown/needs further assessment) was determined by considering potential impairments watershed-wide and has not been officially changed to consider only AOC sources since development of the Stage I RAP in 1993.

In March 2009, Ecology and Environment, Inc. (E & E) issued the *Rochester Embayment Area of Concern Beneficial Use Impairment Delisting Criteria Report* in support of the Rochester Embayment AOC Oversight Committee, the Rochester Embayment RAP Coordinator, the United States Environmental Protection Agency (EPA) Region 2 and Great Lakes National Program Office (GLNPO), and the New York State Department of Environmental Conservation (NYSDEC). The Report establishes delisting criteria and delisting targets for the 14 impaired and unknown BUIs in the Rochester Embayment AOC designated as such in 1993.

The status of those BUIs with local and lakewide use impairments, for which local actions will have minimal remedial impact on those pollutants causing the impairments, including the Drink-

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ing Water Taste and Odor BUI, are being reconsidered in 2009. Ultimately, the delisting of BUIs is a recommendation that must be made by the OC based on review of monitoring data, with the ultimate approval of EPA Region 2 and GLNPO. This report provides information to support the justification for the delisting of the Drinking Water Taste and Odor Problems BUI.

Initial Rationale for Impairment of Drinking Water Taste and Odor Problems

The Stage I RAP indicates that there are no restrictions on drinking treated water anywhere in the Rochester Embayment watershed; however, both the Stage I and Stage II RAP indicate that occasional taste and odor problems were reported to the Monroe County Water Authority (MCWA) regarding water drawn from the Embayment and treated. These occasional taste and odor problems were highest in 1998 and 1999 and are the basis for the listing of the Drinking Water Taste and Odor Problem BUI as impaired in the Rochester Embayment portion of the AOC, where the drinking water intake for the Shoremont Water Treatment Plant is located. There are no water intakes in the Genesee River portion of the AOC; therefore, that section was determined to be not impaired.

The Stage I RAP indicates that drinking water taste and odor problems occurred primarily in August, when prolonged hot temperatures promote blue-green algal growth. This same assumption was made when developing the delisting criteria for this BUI during the 2002 Stage II RAP Addendum development. The assumption stated that “In the Rochester Embayment a drinking water taste and odor problem is defined as a musty/earthy taste and odor due to natural lake processes, and not due to drinking water treatment” (Monroe County 2002).

The Stage I RAP also indicated that non-point source phosphorus is a cause of this BUI, as increased phosphorus, typically a limiting nutrient in lake ecosystems, allows for increased algal growth. Additionally, it identifies that weather phenomena can cause problems in water treatment. Sudden wind shifts can alter currents, changing the temperature or turbidity of the water reaching the supply intakes. Alternatively, it was discussed during the Stage II process that taste and odor problems may actually be attributed to improved water quality in Lake Ontario in the 1990s. Improved water quality has resulted in improved water clarity and depth of light penetration, conditions that allow algae to proliferate. This was believed to be caused by *lower* nutrient loads lakewide, coupled with the proliferation of zebra mussels (Monroe County Drinking Water Oversight Committee [MCDWOC] October 1999).

Delisting Criteria and Monitoring Methods

According to the EPA-approved Rochester Embayment Beneficial Use Impairment Delisting Criteria Report (E & E 2009), the Drinking Water Taste and Odor Problems BUI will be restored when the following delisting criteria are met:

1. Current scientific literature indicates that drinking water taste and odor is a Great Lakes-wide problem; and
2. The scientific literature establishes cause(s) for taste and odor problems; and
3. The Rochester Embayment AOC does not contribute significantly to the taste and odor problem as determined using the findings of Delisting Criteria No. 2.

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The monitoring method developed for this BUI consists of review of scientific literature on an ongoing basis to determine if the Rochester Embayment watershed may contribute to causes of drinking water taste and odor.

Assessment of Information to Support Delisting of the BUI

The MCWA reports that the drinking water testing program that is currently used at the Shoremont Water Treatment Plant substantially exceeds EPA and New York State Health Department requirements. The MCWA's website states that some customers may occasionally experience chlorine-related taste and odor issues, which can be attributed to residual chlorine associated with the maintenance of the distribution system. The website and the last three City of Rochester Water Quality Reports do not however address earthy and musty taste and odors, the original reason for listing this BUI as impaired. Earthy and musty tastes and odors have not been an issue for MCWA since 1999. This is due in part to the installation of granulated activated carbon (GAC) caps in its treatment plants' filters (City of Rochester New York Bureau of Water 2006, 2007 and 2008 and Nugent 2009).

Taste and odor problems reported as a musty/earthy taste and odor due to natural lake processes, and not due to drinking water treatment, were identified as the cause of impairment in the 2002 Stage II RAP Addendum (Monroe County 2002). These problems in the MCWA's drinking water were reported to the Ontario Water Works Research Consortium (OWWRC) as intermittent according to the OWWRC's definition (which indicates that reports of taste and odor problems are not made every year). These occasional instances of earthy/musty taste and odor problems have been reported lake-wide and attributed to the presence of geosmin and 2-methylisoborneol (MIB); however MCWA indicates that earthy and musty taste and odor issues have not been an issue in MCWA since 1999. These issues, which are now historic in MCWA drinking water, are widely recognized as a lake-wide problem, as drinking water intakes throughout Lake Ontario were reporting annual (typically summer) or intermittent drinking water taste and odor problems in the late 1990s and early 2000s (OWWRC 2004).

The OWWRC has supported research on geosmin (see Causes of Lake-wide Taste and Odor Problem Constituents below) in Lake Ontario since 1999 and has found that there is a clear trend in rising geosmin levels annually in western Lake Ontario, indicating that geosmin is not a Rochester Embayment specific issue and that geosmin levels, which cause intermittent taste and odor problem reporting, typically in late summer, are lake-wide issues and are not a direct result of pollutants from the Rochester Embayment AOC. An OWWRC taste and odor survey of Great Lakes water utilities in the summer of 2004 identified that taste and odor problems go beyond Lake Ontario in the Great Lakes system and are also prevalent in Lake Michigan, Lake Erie and Great Lakes river systems. Lakes Huron and Superior had few reported cases of taste and odor problems (OWWRC 2004). Figure 2 shows the survey results and reported frequency of taste and odor issues across the Great Lakes system in 2004.

Closer to Rochester, geosmin and MIB data were collected in conjunction with State University of New York at Brockport in 1999 in the vicinity of the Brockport drinking water treatment plant (outside of the Rochester Embayment AOC). Geosmin and MIB levels found outside of the Embayment were similar to those found within the Embayment (MCDWOC February 2000). The MCDWOC minutes also indicate that the City received the same taste and odor complaints from residents regarding water drawn from the AOC as water drawn from Hemlock Lake (one of the

finger lakes, located outside of the AOC watershed), and most of these complaints are regarding chlorine residual in the water from treatment processes, not the musty/earthy tastes and odors attributed to the BUI (MCDWOC May 14, 1999).

Causes of Lake-wide Taste and Odor Problem Constituents

Taste and odor problems came to the forefront in 1998 and 1999, as there were prolonged periods of intense taste and odor problems reported in Lake Ontario during the late summer during both those years. In 1994 similar events, though less intense, were recorded in western Lake Ontario drinking water (OWWRC 2009). The intensity of these events lake-wide, coupled with the occurrence of taste and odor issues in drinking water drawn from the Rochester Embayment at the time of the development of the Stage II RAP, explains why the RAP OCs concluded that more research was needed to determine whether the Rochester AOC was a direct source of the impairment.

The OWWRC has since conducted research on the presence and causes of geosmin and MIB compounds in Lake Ontario. Geosmin and MIB are both produced in Lake Ontario, presumably by the decay of cyanobacteria and actinomycetes that occur naturally in lake ecosystems, and are at times (typically in late summer) present in excessive amounts due to eutrophication. Eutrophication, and as a result, taste and odor problems, are most prevalent in Lake Ontario in late summer, because warmer temperatures and increased sunlight in combination with nutrient input to the lake ecosystem provide all the limiting factors required by cyanobacteria to proliferate. Geosmin and MIB are produced when cyanobacteria or actinomycetes decay, and human sensitivity to these compounds, particularly geosmin, is very acute. Specifically, the average person can notice the odor of geosmin at 4 ng/L and MIB is noticeable at 9 ng/L and these compounds are difficult to remove with conventional water treatment (OWWRC 2009, Rao et al. 2003, and Zaitlin et al. 2003).

Cyanobacteria and actinomycetes both occur throughout Lake Ontario and are not specific to Rochester Embayment. Phycocyanin, a pigment unique to cyanobacteria has been found to be prevalent at several Lake Ontario shorelines in New York, indicating that this source of taste and odor issues (cyanobacteria) is lakewide. Rochester Embayment concentrations of phycocyanin are lower than those found at the mouth of Oak Orchard Creek, a non-AOC, and are comparable to those found near the Niagara River, where drinking water taste and odor is not impaired (Lake Ontario Coastal Initiative [LOCI] 2005).

Actinomycetes, which produce geosmin and MIB, but are likely less of a factor in taste and odor problems than cyanobacteria in Lake Ontario, are also prevalent throughout the Lake. Actinomycetes are widely believed to be of terrestrial origin and are transferred to aquatic environments through sediments. Zaitlin et al. 2003 supported this theory by finding that actinomycetes were most commonly found in association with sediments in surface water samples and were rarely found in free-floating or offshore sampling stations. Actinomycetes were also found in association with mussel populations and periphyton/macrophytic assemblages, likely attributed to the sediments trapped in these environments. While actinomycetes were found at all sampling locations in the upper and lower Lake (four sampling sites near Toronto and two sampling sites near Moses Saunders Dam), they were found to vary considerably in the amount of geosmin and MIB produced, indicating that not all actinomycetes produce taste and odor causing compounds and that production varies with environmental conditions among those actinomycetes that do. In



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conclusion, while actinomycetes are found lake-wide, their contribution to the taste and odor of drinking water is less predictable, and likely less prevalent, than the contribution of decaying cyanobacteria lake-wide (Zaitlin et al. 2003).

In northwestern Lake Ontario, instances of drinking water taste and odor problems in 1998 and 1999 that were more severe than most years have been attributed to researchers' beliefs that geosmin is being produced by cyanobacteria in the open lake and is delivered to the near shore zone and water intakes after a period of upwelling (calm lake conditions with low turbulence in the upper water column due to weak winds) is followed by downwelling events driven by easterly winds. Current and temperature measurements coupled with geosmin measures show upwelling and downwelling of the Lake's thermocline correlated with an increase in geosmin concentrations at water treatment plants along the north shore of Lake Ontario in Canada following downwelling events (Rao et al. 2003 and OWWRC 2009). The results of this study support the hypothesis that geosmin originates offshore in Lake Ontario and becomes a taste and odor issue when carried to the shore and drinking water intakes by natural processes (Rao et al. 2003).

Rationale for Delisting

The intent of the AOC program is to remedy the impairment when the AOC is the source. Studies since the original status determination of this BUI have identified taste and odor problems as a lakewide impairment that does not originate from pollutants (or other causes of impairments) within the Rochester Embayment AOC. Each delisting criteria is met in the following manner:

1. Current scientific literature indicates that drinking water taste and odor is a Great Lakes-wide problem

The OWWRC's 2004 survey of water purveyors in the vicinity of the Great Lakes identified that taste and odor problems are reported annually or intermittently (in the case of Rochester) at six water treatment plants in Lake Ontario, including the Shoremont Water Treatment Plant in Monroe County and at several water treatment plants on Lake Erie and Lake Michigan (Figure 2).

2. The scientific literature establishes cause(s) for taste and odor problems

Causes of musty/earthy taste and odor problems are widely recognized as geosmin and MIB, which have been studied as an issue affecting drinking water taste and odor in other areas of Lake Ontario, particularly on the northwest shore of the Lake in Ontario. Literature supports that these compounds are produced off-shore (Rao et al. 2003).

3. The Rochester Embayment AOC does not contribute significantly to the taste and odor problem as determined using the findings of Delisting Criteria No. 2.

Geosmin and MIB are believed to be produced in the open lake by decaying algae and/or actinomycetes. While the Rochester Embayment's watershed may contribute phosphorus and other nutrients that contribute to algal growth in the Embayment, taste and odor events associated with musty and/or earthy tastes and odors have not been identified in the Rochester Embayment since 1999. Contributory watershed sources of impairments are not addressed by the AOC program, the intent of which is to only list BUIs when the AOC itself is the



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source of the impairment. That stated, the literature reviewed appears to attribute lake-wide causes as the primary source of historic spikes of geosmin and MIB in the Rochester Embayment. Contributions of nutrients from outside the AOC and several other tributaries to the lake, which contribute to lake-wide algal proliferation, are likely a secondary factor when considering taste and odor problems. Additionally, there is no literature supporting that the source of historic taste and odor problems in drinking water drawn from the Rochester Embayment are caused by sources originating from within the AOC itself.

The lack of reports of musty taste and odor issues since 1999 to the MCWA further supports the need to delist this BUI, as an actual drinking water taste and odor problem related to musty and earthy tastes and odors has not been reported in nearly a decade.

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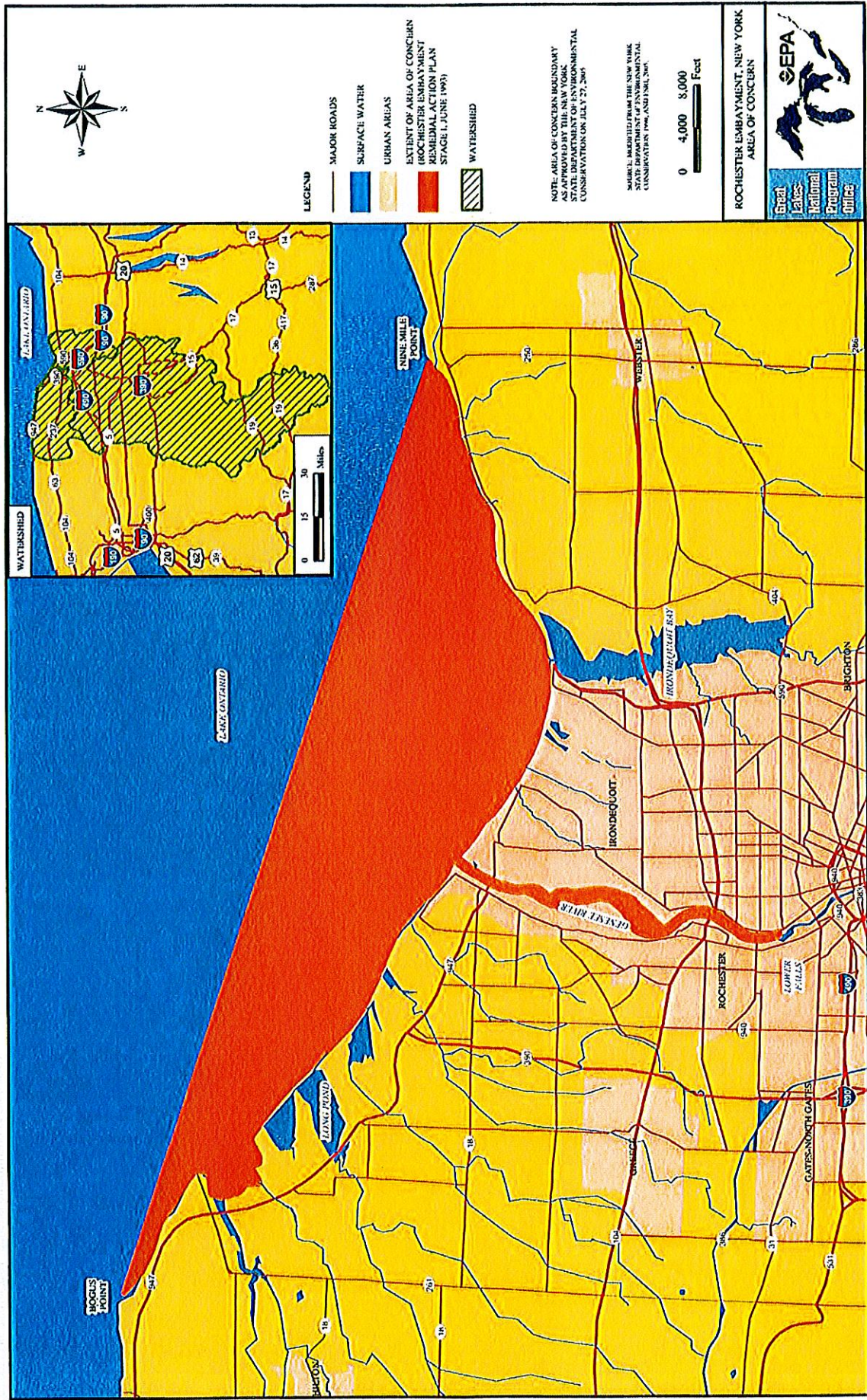


Figure 1 Rochester Embayment, New York Area of Concern

Figure 2 Great Lakes Taste and Odour: Location and Frequency

